REMARKS

This application has been carefully reviewed in light of the Office Action dated June 18, 2003. Independent claims 8 and 42-45 have been amended. Claims 2-5, 8, 10-12 and 42-45 are pending. Applicants respectfully request reconsideration of the above-referenced application in light of the amendments and following remarks.

At the outset, Applicants respectfully submit that this Amendment is timely filed on September 22, 2003. The U.S. Patent and Trademark Office was closed on September 18th and September 19th due to Hurricane Isabel. Accordingly, a petition for extension of time is not necessary and does not accompany the present Amendment.

In the present Amendment, claims 8 and 42-45 have been amended to recite in pertinent part that "the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure." Support for this recitation is found in Applicants' specification at page 9, lines 2-5.

Claims 8 and 42-45 stand rejected under 35 U.S.C. § 112, first paragraph as allegedly failing to comply with the enablement requirement. Claims 8 and 42-45 have been amended to overcome the Examiner's concern. Withdrawal of the rejection is solicited.

Claims 8, 2-5, 10-12 and 45 stand rejected under 35 USC § 103(a) as allegedly being unpatentable over Patel, in view of either Emesh or Chivukula, and further in view of Van Zant. Reconsideration is respectfully requested.

The cited references do not teach a method of fabricating a semiconductor device comprising "depositing an oxygen-deficient dielectric film . . . subjecting the dielectric film to a wet oxidation with steam process provided by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature of at least about 450°C . . . said steam provided in a ratio of at least 0.005 relative to other gases . . . wherein the ratio of hydrogen to oxygen gases is in the range of about 0.1 to about 0.8,

and wherein the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure," as recited in claim 8 (emphasis added), or "depositing an oxygen-deficient dielectric film . . . subjecting the dielectric film to a single wet oxidation anneal process consisting of steam provided by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature of at least about 450°C. . . wherein the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure," as recited in claim 45 (emphasis added).

The above rejection relies on the combined teachings of three different references which are not properly combinable. Patel does not teach or suggest "a wet oxidation with steam process," as recited in claim 8 or "a single wet oxidation anneal process," as recited in claim 45. Patel also does not teach or suggest that "the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure," as recited in claims 8 and 42-45.

The Office Action argues that "Patel clearly teaches that the annealing of the PZT layer may be a single anneal or a plurality of anneals and teaches anneal times up to an hour (Patel, Col. 4, lines 55-66). Applicants respectfully submit that Patel teaches at least two anneals. Patel teaches "[a] first anneal is then performed on ferroelectric material 14 . . . in an ozone atmosphere using a rapid thermal anneal process (RTA) or a furnace anneal . . . [and] [a] second anneal, annealing the entire stack (12, 14, 16), is performed . . . using either a furnace anneal or RTA." (Col. 3, lines 62-65 and Col. 4, lines 55-57) (emphasis added). Patel's PZT layer is annealed at least twice. Accordingly, Patel does not teach or suggest a "single wet oxidation anneal process," as recited in claim 45.

Moreover, there is no motivation to combine the cited references. Patel teaches an anneal process that is "conducted at a temperature in the range of about 650°C. to about 850°C. for about five to thirty seconds." (Col. 4, lines 11-15) (emphasis added). In contrast, Emesh teaches that a "method is provided having a reduced thermal budget, i.e., low temperature anneal (450° – 500°C) and relatively short anneal times (e.g., several

minutes) compared with known prior art methods." (Col. 4., lines 5-8).

The Office Action asserts that "Emesh would clearly reduce the necessity of the longer anneal times used in Patel." (Office Action, pg. 13) (emphasis added). Applicants respectfully submit that Emesh teaches a longer anneal time with the presence of water vapour. Patel teaches a shorter anneal time. Emesh teaches a low temperature anneal i.e., below 500°C. Patel teaches an anneal temperature greater than 650°C. The two references teach different anneal temperatures and durations. Accordingly, there is no motivation to combine the two references since one skilled in the art would want an anneal process that is shorter rather than longer for increased throughput. Further, one skilled in the art would not combine references that teach two different anneal temperatures.

In fact, Patel benefits from employing higher temperatures i.e., above 500°C, and further teaches that ozone molecules will disassociate quickly decreasing the anneal time to less than 30 seconds; thus, increasing the diffusion of oxygen into the ferroelectric crystal. (See Col. 4, lines 18-22). This is the primary benefit that Patel teaches. One skilled in the art would not combine Patel with Emesh, since Emesh teaches a lower temperature anneal i.e., below 500°C. Moreover, one skilled in the art would not employ water vapour with Patel's teachings since Emesh teaches that using water vapor in annealing the ferroelectric layer increases the annealing time. The two references clearly teach away from each other.

The Office Action further contends that Patel and Emesh are properly combinable since Emesh teaches "reducing the stress in the ferroelectric film," (Office Action, pg. 5). Emesh teaches that "ferroelectric films may be highly stressed. High Stress may cause poor adhesion to the substrate, which results in peeling, and stress is also associated with fatigue." (Col. 2, lines 39-43) (emphasis added). However, this is not a concern in Patel. Patel teaches that a "preliminary anneal is then performed to anneal bottom electrode 12 . . . [which] improves the adhesion between the bottom electrode and the subsequently deposited ferroelectric material." (Col. 3, lines 29-40) (emphasis added).

As a result, Patel teaches reducing the stress in the ferroelectric film through a preliminary anneal. Patel teaches six different anneals to reduce the stress in the ferroelectric film (See Col. 3, line 63 – Col. 6, line 18). For instance, Patel teaches that "this second anneal improves the ferroelectric characteristics," (Col. 4, lines 64-66). Patel merely teaches that "[g]ases like oxygen, ozone or air can be used in the annealing process." (Col. 4, lines 10-11). Accordingly, there is no motivation to incorporate water vapour with Patel's teaching since Patel's multiple anneals ensures that the stress in the ferroelectric film is decreased.

Moreover, even if Patel and Emesh are properly combinable, which they are not, they would still fail to teach or suggest that "said steam [is] provided in a ratio of at least 0.005 relative to other gases . . . [and] wherein the ratio of hydrogen to oxygen gases is in the range of about 0.1 to about 0.8, and wherein the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure," as recited in claim 8.

Applicants also respectfully submit that the cited references, Patel and Chivukula, are not properly combinable. Chivukula teaches an anneal time of at least "30 seconds to several minutes," (Col. 13, lines 39-40). However, Patel teaches an anneal time of less than 30 seconds. As a result, one skilled in the art would not combine Patel and Chivukula since Chivukula teaches a longer anneal time and this would decrease throughput. As discussed previously, Patel is directed to increasing the diffusion rate of oxygen into the ferroelectric layer thereby decreasing the anneal time. Thus, there is no motivation to combine two references that teach away from each other.

Van Zant is relied upon for another feature and does not rectify the deficiencies associated with Emesh or Chivukula. In particular, there is no motivation to combine Patel with Emesh and Chivukula, Patel clearly teaches at least two different anneals, and Patel does not teach or suggest a wet oxidation anneal process.

Accordingly, even if the references were combinable as the Office Action asserts,

which they are not, the combination would still fail to teach or suggest a method of fabricating a semiconductor device by ""depositing an oxygen-deficient dielectric film . . . subjecting the dielectric film to a wet oxidation with steam process provided by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature of at least about 450°C . . . said steam provided in a ratio of at least 0.005 relative to other gases . . . wherein the ratio of hydrogen to oxygen gases is in the range of about 0.1 to about 0.8, and wherein the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure," as recited in claim 8 (emphasis added), or "depositing an oxygen-deficient dielectric film . . . subjecting the dielectric film to a single wet oxidation anneal process consisting of steam provided by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature of at least about 450°C. . . wherein the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure," as recited in claim 45 (emphasis added).

Claims 2-5 and 10-12 depend from and include all of the limitations of independent claim 8 and are similarly allowable along with claim 8.

Claim 42 stands rejected under 35 USC § 103(a) as being unpatentable over Patel in view of either Emesh or Chivukula, and further in view of Ohmi and considered with the CRC Handbook of Chemistry and Physics 63rd Edition. Reconsideration is respectfully requested.

For at least the reasons provided above, the cited references Patel, Emesh, and Chivukula are not properly combinable. In particular, there is no motivation to combine Patel with Emesh and Chivukula. Patel clearly teaches at least two different anneals, and Patel does not teach or suggest a wet oxidation anneal process. Patel, Emesh and Chivukula also teach different anneal temperatures and times from each other.

Moreover, Ohmi and the CRC Handbook of Chemistry and Physics 63rd Edition add nothing to rectify the deficiencies associated with those cited references. In particular,

the cited references do not teach or suggest a method of fabricating a semiconductor device comprising "depositing an oxygen-deficient dielectric film . . . subjecting the dielectric film to a wet oxidation with steam process provided by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature of at least about 450°C . . . said steam provided by a catalytic system in a ratio of at least 0.005 relative to other gases present in the rapid thermal process chamber, and wherein the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure," as recited in claim 42 (emphasis added). Accordingly, it is respectfully requested that this rejection be withdrawn.

Claim 43 stands rejected under 35 USC § 103(a) as being unpatentable over Patel in view of the excerpt from Ghandi, and either of Emesh or Chivukula and considered with the CRC Handbook of Chemistry and Physics 63rd Edition. Reconsideration is respectfully requested.

For at least the reasons provided above, the cited references Patel, Emesh, and Chivukula are not properly combinable. Patel clearly teaches at least two different anneals, and Patel does not teach or suggest a wet oxidation anneal process. Patel, Emesh and Chivukula also teach different anneal temperatures and times from each other.

Moreover, Ghandi and the CRC Handbook of Chemistry and Physics 63rd Edition add nothing to rectify the deficiencies found in those cited references. In particular, the cited references do not teach or suggest a method of fabricating a semiconductor device comprising "depositing an oxygen-deficient dielectric film . . . subjecting the dielectric film to a wet oxidation with steam process provided by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature of at least about 450°C . . . said steam provided by a pyrogenic system in a ratio of at least 0.005 relative to other gases present in the rapid thermal process chamber, and wherein the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure," as recited in claim 43 (emphasis added). Accordingly, it is respectfully requested that this rejection be withdrawn.

Claim 44 stands rejected under 35 USC § 103(a) as being unpatentable over Patel in view of either Emesh or Chivukula and considered with the CRC Handbook of Chemistry and Physics 63rd Edition. Reconsideration is respectfully requested.

For at least the reasons provided above, the cited references Patel, Emesh, and Chivukula are not properly combinable. Patel clearly teaches at least two different anneals, and Patel does not teach or suggest a wet oxidation anneal process. Patel, Emesh and Chivukula also teach different anneal temperatures and times from each other.

Moreover, the CRC Handbook of Chemistry and Physics 63rd Edition adds nothing to rectify the deficiencies found in those cited references. In particular, the cited references do not teach or suggest a method of fabricating a semiconductor device comprising "depositing an oxygen-deficient dielectric film . . . subjecting the dielectric film to a wet oxidation with steam process provided by heating a mixture of hydrogen and oxygen gases in a rapid thermal process chamber at a temperature of at least about 450°C . . . said steam provided by a bubbled water vapor system in a ratio of at least 0.005 relative to other gases present in the rapid thermal process chamber, and wherein the pressure of said rapid thermal process chamber is in the range from about 1 milliTorr to less than atmospheric pressure," as recited in claim 44 (emphasis added). Accordingly, it is respectfully requested that this rejection be withdrawn.

In summary, for all of the reasons set forth above, the cited references, whether considered alone or in combination, fail to disclose or suggest the above-mentioned features of the claimed invention. Allowance of the application with claims 2-5, 8, 10-12, and 42-47 is respectfully solicited.

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Respectfully submitted,

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